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April 2, 1973

(NASA-TM-X-69267) ATLAS/CENTAUR PIONEER G OPERATIONS SUMMARY (NASA) 43 p HC $4.25 CSCL 22C

N73-25885

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ATLAS/CENTAUR 30
PIONEER G

OPERATIONS SUMMARY

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Prepared by
Spacecraft and Vehicle Support Operations Branch, KSC-ULO

TR-1230
April 2, 1973

ATLAS/CENTAUR

PIONEER G

OPERATIONS SUMMARY

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MISSION

A. MISSION OBJECTIVE

Pioneer G is the second in a series of scientific spacecraft designed to return information from previously unexplored parts of the solar system. It will fly beyond the orbit of Mars, pass through the asteroid belt, gain speed while performing a fly-by of Jupiter, and continue on into space.

An almost identical spacecraft, Pioneer 10, was launched from Cape Kennedy on March 2, 1972, and will perform a fly-by of Jupiter in December of 1973. The primary objectives of both spacecraft are to conduct exploratory scientific investigation of:

1. The interplanetary medium beyond the orbit of Mars.

2. The nature of the Asteroid Belt.

3. The environmental and atmospheric characteristics of the Planet Jupiter, largest in the solar system.

A secondary mission objective of Pioneer G and Pioneer 10 is to advance the technology and operational capability for long-duration flights to the outer planets.

The refined trajectory of Pioneer G will not be determined until approximately a year after launch, when data from the Pioneer 10 fly-by of Jupiter has been received and evaluated. Depending on the success of the first mission, and what is learned of the environment around Jupiter, Pioneer G may be programmed to repeat the fly-by performed by Pioneer 10, swing in closer or further from the planet, fly-by on a different trajectory, or travel on past Jupiter to Saturn.

If the Saturn option is the one exercised, Pioneer G will become the first probe to the solar system's second largest planet. Saturn is unique for its astronomically beautiful orbiting ring system. Any photographs or other direct data obtained on this planet would be the first of its kind.

Pioneer G will be launched on an ATLAS/CENTAUR launch vehicle (AC-30) from complex 36B, Cape Kennedy. The launch vehicle will be fitted with a spin-stabilized, solid propellant third stage. The powered flight will be direct ascent, with an injection velocity of about 52,000 kilometers (32,400 miles)/hour. (Refer to figure 1).

B. LAUNCH VEHICLE AND SPACECRAFT DESCRIPTION

1. <u>Launch Vehicle</u>.

a. ATLAS. The ATLAS stage (S/N 5011D) for the AC-30 mission is the SLV-3D. Propulsion of the ATLAS is provided by an MA-5 Rocketdyne engine group consisting of a booster engine with two thrust chambers, a sustainer engine, and

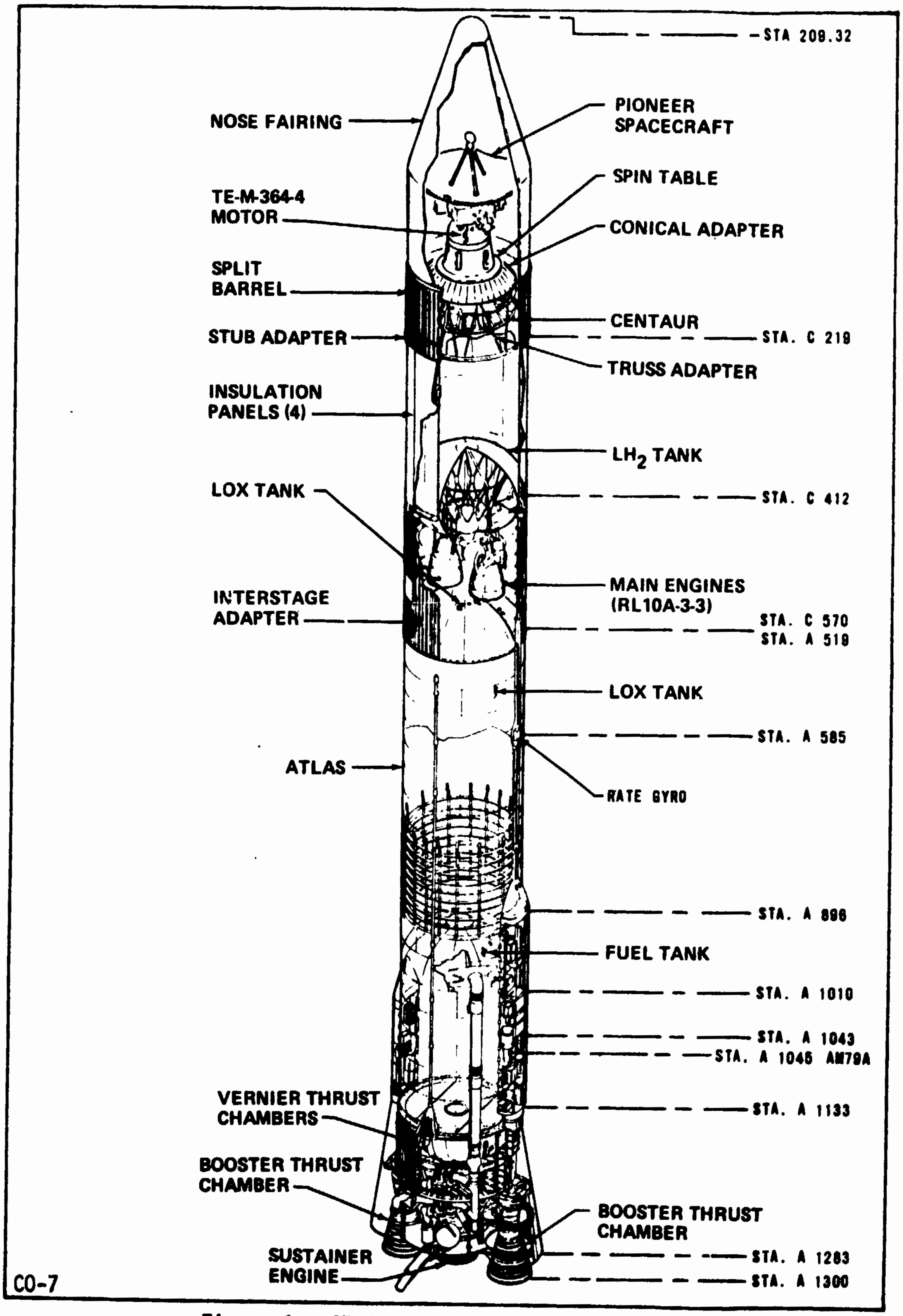


Figure 1. ATLAS/CENTAUR-30 Launch Vehicle

two vernier engines. All are single-start, fixed-thrust, liquid propellant engines which provide a combined thrust of 431,383 pounds at liftoff. Liquid oxygen and RP-1 are used as propellants. The vernier engines are free to gimbal in the pitch plane only for roll control thrust during sustainer flight. The CENTAUR Digital Computer Unit (DCU) system will roll the vehicle to the proper flight azimuth during the first 2 to 15 seconds of the flight. Vehicle guidance and control during the ascent will be provided by DCU, Inertial Measurement Group (IMG), System Electronics Unit (SEU), Sequence Control Unit (SCU), and the Servo-Inverter Unit (SIU). The guidance steering will be determined by prelaunch upper air wind soundings. The complete CENTAUR guidance system is enabled for trajectory control at 8 seconds after Booster Engine Cutoff (BECO). One lightweight telemetry package to monitor inflight performance and two new Avco AED101 command receivers for Range Safety purposes will be aboard the ATLAS.

b. CENTAUR. The CENTAUR stage is S/N 01A01. The new CENTAUR D-1A astrionic system integrates many former hardware functions into airborne computer software. The Teledyne digital computer unit is an advanced, high speed computer with a 16,384 word random access memory. From the DCU, discrete commands are provided to the sequence control unit. Engine commands go to the servo-inverter unit through three D-C Digital-to-Analog (D/A) converters in the DCU.

The Honeywell inertial measurement group guidance system contains a four-gimbal, all-attitude stable platform. Three gyros stabilize this platform on which are mounted three pulse-rebalanced accelerometers. A prism and window allow for optical azimuth alignment prior to launch. Resolvers on the platform gimbals transform inertial vectors into vehicle coordinates. These vectors are computed in the DCU. A crystal oscillator, which is the primary timing reference, for DCU and 400 Hz inverters, is also contained in the IMG.

The Central Controller Unit (CCU) for the CENTAUR Pulse Code Modulation (PCM) telemetry system is housed in the same package as the DCU and shares the DCU memory. The CCU has replaced the PCM commutator used on CENTAUR model 19C The advantage of the new system is that PCM formating is now controlled completely by software. System capacity is 267,000 bits/second. The central controller unit will service three Teledyne remote multiplexer units.

Flight trajectory is controlled by the IMG and DCU which utilizes the main engines for thrust vector control, and an improved hydrogen peroxide system for attitude control. The main engines are the Pratt and Whitney production model RL10A-3-3 improved performance type.

c. Third Stage. The third stage major assemblies consist of a spin table, TE-M364-4 third stage motor, batteries, telemetry system, C-Band radar transponder, destruct system, motor separation Marmon clamp, spacecraft attach fitting, and a spacecraft separation Marmon clamp. The third stage-to-CENTAUR interface is between the CENTAUR mission-peculiar conical adapter and the spin table's lower (non-rotating) conical adapter.

The TE-M364-4 rocket motor is an elongated version of the third stage DELTA rocket motor. Its average thrust is nominally 14,900 pounds over its burn time of approximately 44 seconds.

2. Spacecraft. The Pioneer G spacecraft (figure 2) has a hexagonally-shaped thermally controlled equipment compartment with a 9-foot diameter parabolic-dish high-gain antenna on the forward end. The spacecraft is divided into two sides. On one side, a pair of Radioisotope Thermoelectric Generator (RTG) units are mounted in tandem on each of two support trusses consisting of three struts. The struts are attached to the spacecraft structure by fittings that permit the trusses to slide outward from near the spacecraft body to the extended position as the RTG units deploy after spacecraft separation. The centerlines of the two support trusses are approximately 120 degrees apart. When deployed, the center of each RTG pair is about 104 inches from the stowed configuration spin axis. This side of the spacecraft body contains most of the electronic system such as power converters, receivers, and data handling equipment which relate solely to the spacecraft systems.

On the side of the spacecraft opposite the RTG units is a boom with a magnetometer sensor at the end. The remaining scientific instruments are either in the interior or attached to the exterior of the equipment compartment on this same side of the spacecraft. The low-gain omnidirectional antenna and the asteroid/meteroid detector (located 180 degrees apart) extend below the spacecraft/launch vehicle interface plane.

The spacecraft achieves dynamic stability during flight by spinning between 2.2 and 7 rpm (4.8 rpm nominal). When all appendages and the RTG units are stowed in the launch configuration, the spin axis passes through the center of the attach fitting to the launch vehicle/spacecraft interstage structure and the high-gain parobolic-dish antenna. When the appendages and RTG units are deployed, the spin axis is parallel to that during launch, but is offset as a result of the change in center of mass due to deployment of the RTG units. The spin axis points toward Earth for a major portion of the mission to achieve the communication capabilities afforded by the parabolic-dish antenna. The spin rate is controlled by a pair of thrusters, each capable of producing 1.0 pound of thrust. The spacecraft attitude control is controlled by two pair of precision thrusters rated at 1.0 pound of thrust each. The spacecraft has the capability of making modest changes in its velocity during the interplanetary phase by means of the same two pair of thrusters so that the desired encounter trajectory can be achieved.

Pioneer G will carry 12 scientific instruments, including an imaging photopolarimeter capable of taking pictures of a planet that can be transmitted to Earth. The others are a helium vector magnetometer, plasma analyzer, charged-particle instrument, Geiger-tube telescope, cosmic ray telescope, trapped-radiation detector, ultra-violet photometer, infrared radiometer, asteroid/meteoroid detector, meteoroid detector, and a second magnetometer. Two experiments, S-band occultation and celestial mechanics, use only the spacecraft communications system.

The Pioneer G spacecraft was built by TRW Systems Incorporated, and will weight about 570 pounds at launch.

3. Nose Fairing. The Pioneer G nose fairing is a conical-cylindrical shroud incorporating a cork thermal barrier and a spring jettison system. The nose fairing extends approximately 14 feet above the top of the spacecraft to the bottom of the interstage adapter and is retained around the spacecraft until after CENTAUR engine start to protect the spacecraft during flight through the atmosphere and from ATLAS retrorocket exhaust.

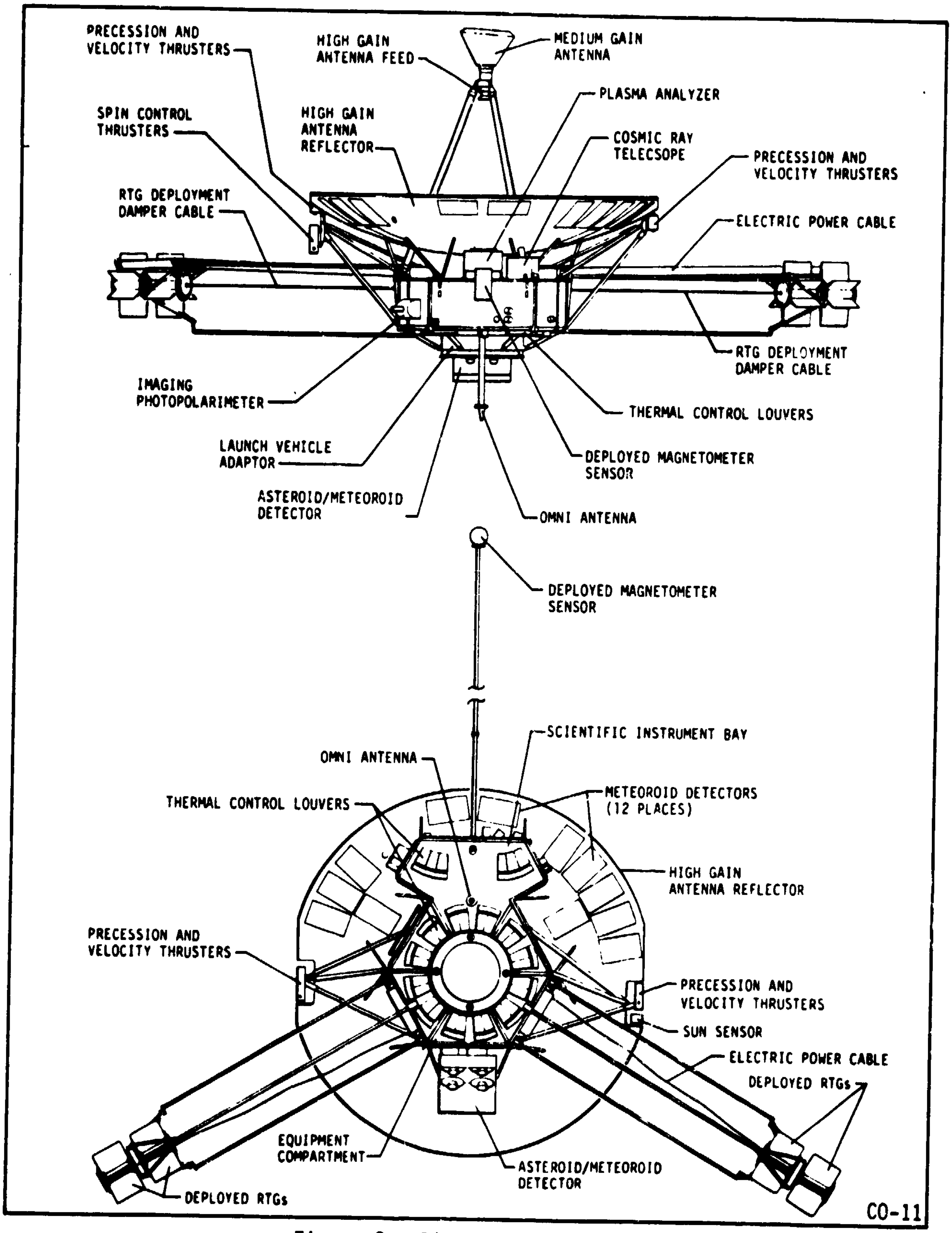


Figure 2. Pioneer G Spacecraft

C. MISSION PLAN

1. Launch Constraints.

a. Launch Opportunities. The launch period for Pioneer G will commence on April 5, 1973 and run through April 26, 1973. The window on April 5 will open at 2111 EST and close at 2156 EST. The trip time to Jupiter, in days, will vary from between 602 to 825 dependent on the launch day. The launch azimuth sector will be from 108 to 120 degrees and will vary with regard to launch day and time of launch within the window.

b. Wind Conditions. Wind velocity and direction, as measured at a 90-foot altitude by an anemoneter and recording system, as well as the output of the ATLAS pitch and yaw rate gyros, will be continuously monitored during the countdown by meters and an oscillograph recorder in the blockhouse. In the event ground winds and/or rate gyro indications exceed the maximum allowable limits, appropriate action will be taken to obtain a safe configuration. The most restrictive conditions for wind velocity occur during the later tanking operations.

Vehicle aerodynamic loads, which are calculated from upper wind observations, must be within specified design limits. In particular, wind shears at flight levels around maximum Q are critical. Starting at F-1 day periodic soundings will be obtained from the Eastern Test Range (ETR), Windsonde, Rawinsonde, and Jimsphere balloons, and data received will be transmitted to San Diego for computer processing. The results will then be relayed to the Mission Director's Center (MDC) for use in determining if the resultant aerodynamic loads which are expressed in percentage of maximum allowable loads, are acceptable for launch.

For AC-30, a completely new system of flight-wind restriction procedures will be used for the first time. The major change involves a new CDC CYBER 70 computer program called "ADDJUST" for generation of ATLAS/CENTAUR airborne flight-wind pitch and yaw programs. This ADDJUST program will provide more flexibility in adapting to changing wind conditions and hence an improved flight-wind launch availability.

2. ATLAS/CENTAUR Requirements. All vehicle systems must be operational at the time of launch. Priorities and requirements for telemetry measurements are available on prepared forms in the CENTAUR operations office.

3. Spacecraft Requirements. All spacecraft subsystems must be functioning prior to launch as required by the operational parameters of the F-0 day countdown. In addition, spacecraft telemetry required for the conduct of in-flight operations must be in an operational status at the time of launch.

4. Range Safety. Range Safety requires a line-of-sight visibility extending from the radars and skyscreens to the vehicle on the launch pad.

5. Flight Plan. A direct ascent launch mode will be used to accelerate the vehicle from launch to the required Earth-escape trajectory conditions, consisting of four contiguous burning phases by the ATLAS booster, ATLAS sustainer, the CENTAUR, and the third stage. Typically, final (third stage) burnout will occur about 14 minutes after liftoff at approximately 2,400 nautical miles downrange and at an altitude of 100 to 200 nautical miles. The ATLAS/CENTAUR vehicle will rise vertically from Launch Complex 36B until 15 seconds of flight time has elapsed. During the interval from 2 to 15 seconds, the ATLAS flight control system rolls the vehicle from the launch pad azimuth (115 degrees) to the desired launch azimuth. The vehicle then executes a preprogrammed pitch maneuver in the downrange direction. Termination of the booster phase of flight is initiated by a staging discrete (BECO) issued by CENTAUR guidance when an acceleration level of 5.7g is sensed. The booster engine package is jettisoned 3.1 seconds after the staging discrete is issued. (Refer to figure 3 for tracking stations and trajectory.)

CENTAUR guidance steering signals are admitted to the ATLAS stage autopilot eight seconds after BECO, and the system operates in a closed-loop mode throughout the remainder of the flight. During the sustainer phase of flight, the insulation panels are jettisoned. The sustainer phase is terminated by a discrete Sustainer Engine Cutoff (SECO) from a pressure sensor in the fuel manifold in response to oxidizer depletion and causes the sustainer and vernier engines to be shut down. The CENTAUR digital computer unit at SECO +11.5 seconds energizes the electrical disconnect, fires the flexible linear-shaped charge to separate the CENTAUR stage, and fires the eight ATLAS retrorockets to back the ATLAS away from the CENTAUR. Prior to SECO, the DCU initiates the CENTAUR stage prestart sequence: the boost pumps are started and brought up to speed and propellants flow through the CENTAUR fuel and oxidizer system, chilling down the hardware to preclude cavitation at CENTAUR Main Engine Start (MES).

The signal for starting the CENTAUR main engines is issued by the DCU. Guidance steering commands are nulled at SECO and readmitted at MES plus 20 seconds, after the engine start transient has passed. The nose fairing is jettisoned at MES plus 12 seconds. During the burn, CENTAUR DCU will generate pitch and yaw steering maneuvers in order to obtain the correct launch-time-dependent terminal conditions required at CENTAUR Main Engines Cutoff (MECO). CENTAUR MECO will be commanded by a guidance discrete when these terminal conditions are met.

Following MECO, an 85-second coast period occurs prior to ignition of the third stage. During the first 70 seconds of this period, the CENTAUR performs an orientation maneuver to align the vehicle to the attitude required for third stage ignition. The third stage/spacecraft assembly is then spunup and separated from CENTAUR as a result of two discrete signals issued by the CENTAUR DCU. The first discrete, issued at MECO plus 70 seconds, performs the following four functions within the third stage:

a. Ignites the Third Stage Spin Rockets. Eight solid propellant rockets mounted on the spin table, burn for approximately one second causing the entire third stage/spacecraft assembly to spin up to a nominal 60 rpm.

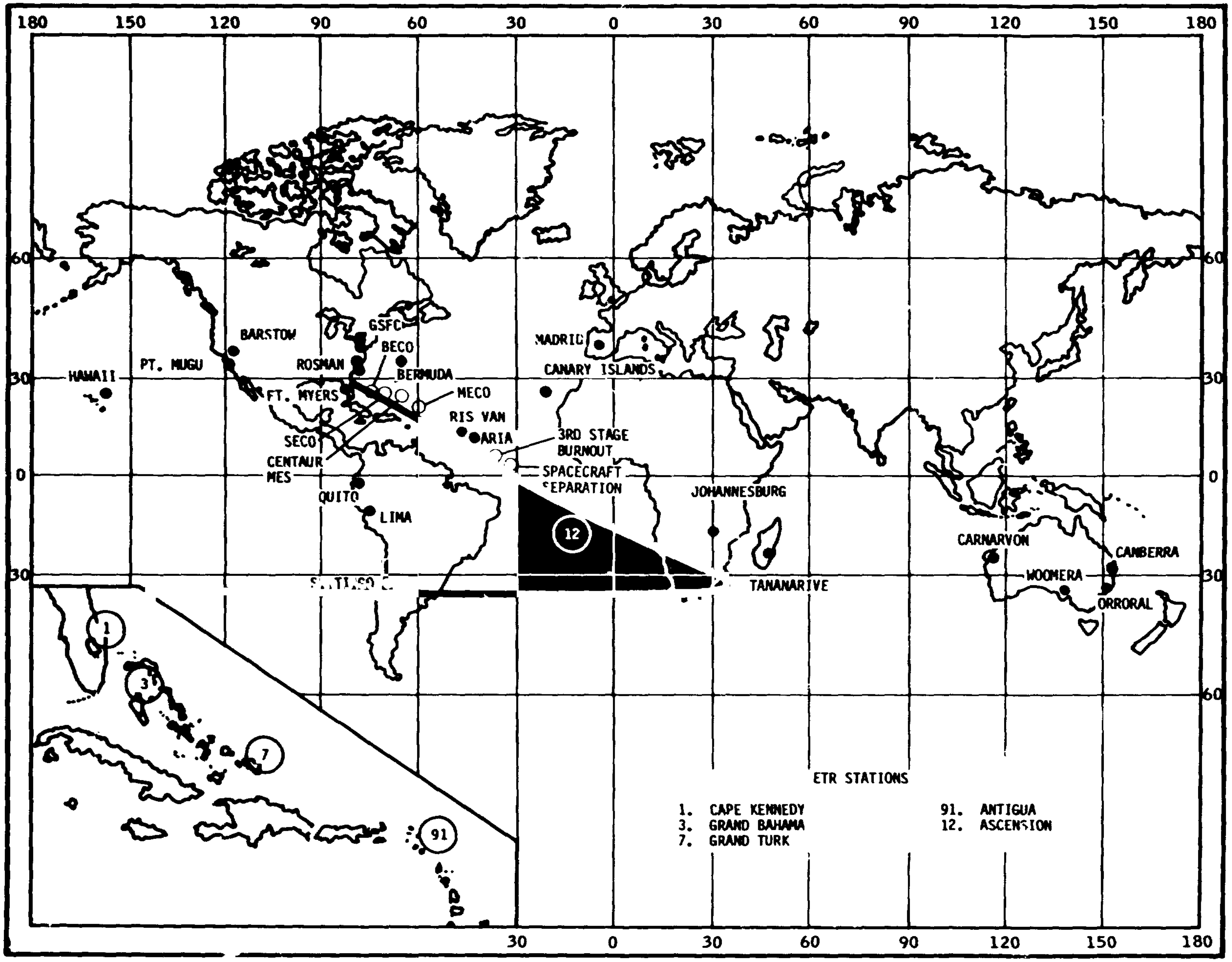


Figure 3. Spacecraft Tracking and Trajectory

b. Starts the Third Stage Sequence Timer. The sequence timer establishes the sequence of operations during third stage burn, spacecraft separation from the third stage, and third stage tumble maneuver.

c. Starts the Third Stage Motor Ignition Fuse. The motor fuse is a nominal 15-second delay fuse and motor ignition occurs approximately 15 seconds after the CENTAUR DCU issues the first discrete signal.

d. Energizes the Third Stage Wire Cutter Squib Switches. The wire cutter squib switches actuate in approximately one second, applying power to two (redundant) pyro-actuated wire cutter devices. Actuation of the wire cutters severs all electrical connections between the third stage vehicle and the spin table.

The second discrete signal, issued at MECO plus 72 seconds, initiates separation at the third stage from the CENTAUR. Two pyrotechnic assemblies, on a Marman clamp securing the spin table four-segment petal adapter to the third stage motor, are ignited and the Marman clamp drops free. Centrifugal force then swings the adapter segments back on their hinges releasing the third stage.

At MECO plus 72.02 seconds (one DCU compute cycle after third stage separation command), the CENTAUR initiates a retrothrust maneuver designed to back the CENTAUR away from the third stage a minimum of 25 feet by the time of third stage ignition. The retrothrust impulse is produced by venting residual gas from the CENTAUR helium bottle through two small nozzles mounted on opposite sides of the CENTAUR aft bulkhead. The two nozzles, which point forward at 45 degree angles outboard from the vehicle centerline, feed from a common explosively-actuated valve controlled by the CENTAUR DCU. No deflection maneuver subsequent to achieving the 25-foot separation distance is required.

At MECO plus 85 seconds (13 seconds after third stage separation), the third stage TE-M-364-4 motor is ignited initiating the fourth (and final) powered phase. The third stage, being spin stabilized and unguided, burns for approximately 44 seconds at an average thrust of 14,900 pounds providing a thrust impulse of fixed magnitude and constant direction. Since spacecraft injection occurs at third stage burnout, achievement of the required launch-time-dependent injection parameters (using the fixed-performance third stage) involves varying the CENTAUR MECO conditions.

Approximately 101 seconds after third stage burnout, the spacecraft is separated from the third stage. Spacecraft release is initiated by the third stage sequence timer, which fires two pyrotechnic devices on a Marman clamp securing the spacecraft to the third stage attach fitting. After release, the Marman clamp segments are restrained to the third stage to prevent collision with the spacecraft. A relative velocity of approximately 4.6 feet/second is imparted between the two vehicles at separation, by a group of four matched springs compressed between the third stage/spacecraft interface structures. Each of the springs is 1.567 inches in diameter and extend from a compressed length of 2.7 inches to a nominal length of 6 inches, with a spring constant of 30.3 pounds/inch.

Following spacecraft separation, the third stage is placed into a tumble mode specifically designed to preclude any bumping of the spacecraft by the third stage as a result of potential residual "coughing or chugging" thrust impulses emitted by the still warm TE-M-364-4 motor. This tumble mode is achieved by using the centrifugal force of the spinning vehicle to displace a small weight (called "Yo-weight") attached to the forward end of the third stage, thereby disturbing the dynamic balance of the vehicle and creating a wobble motion about its spin axis. Under such gyrating motion, any residual TE-M-364-4 thrust impulses would cause the third stage to move in a direction away from the spacecraft rather than toward it. Release of the Yo-weight is accomplished by the firing of either of two (redundant) pyrotechnic devices, initiated by a signal from the third stage sequence timer.

After separating from the third stage, Pioneer G performs four events which are initiated and controlled automatically by the spacecraft utilizing an onboard sequencer (started at spacecraft separation) and/or by commands stored prior to launch. Starting at approximately 17 minutes after separation, the spacecraft despins itself from the spin rate at third stage burnout to approximately 23 rpm. This reduced spin rate enables safe deployment (by centrifugal forces) of the spacecraft RTG units, followed by the magnetometer boom. This redistribution of mass outboard from the spacecraft's central structure, results in a further reduction in the spin rate to approximately 4.8 rpm due to the transfer to momentum energy. The fourth event is completed approximately 5 hours after spacecraft separation, consisting of a reorient maneuver to point the spacecraft high gain antenna (and spin axis) toward the earth. Once attained, the spacecraft maintains this attitude throughout the majority of the mission.

Following spacecraft in-flight separation and acquisition by the NASA Deep Space Network (DSN), all subsequent spacecraft operations will be centered in the Space Flight Operations Facility in Pasadena, California under direction of an Ames Research Center Flight Director.

6. Nominal Sequence of Flight Events. A listing of the ATLAS/CENTAUR/Third Stage major flight events, showing the criteria reference and nominal timing from launch for each, is presented in Table 1.

Table 1. Sequence of Events (Nominal Times)

Event	Criteria Reference	Time From Launch (seconds)
Liftoff (2-inch motion)	T=0	0.0
Start roll	T+2 seconds	2.0
End roll, start pitchover	T+15 seconds	15.0
Enable, booster staging	a_T=100 feet/second^2	99.2

Table 1. Sequence of Events (Nominal Times) (Cont'd)

Event	Criteria Reference	Time From Launch (seconds)
Booster engine cutoff	a_T=5.7 g's	139.1
Booster engine cutoff backup	a_T 50 feet/second^2	---
Jettison booster section	BECO + 3.1 seconds	142.2
Admit guidance steering	BECO + 8 seconds	147.1
Jettison insulation panels	BECO + 45 seconds	184.1
Start CENTAUR boost pumps	BECO + 73.5 seconds	212.6
Enable ATLAS SECO	BECO + 98 seconds	237.1
Sustainer and vernier engines cutoff	Propellant depletion	248.3
Sustainer engine cutoff backup	a_T 10 feet/second^2	---
Inhibit guidance	SECO + 0	248.3
ATLAS/CENTAUR separation	SECO + 1.9 seconds	250.2
Fire ATLAS retrorockets	SECO + 2.0 seconds	250.3
CENTAUR prestart (start engine chilldown)	SECO + 3.5 seconds	251.8
CENTAUR main engine start	SECO + 11.5 seconds	259.8
Jettison nose fairing	MES + 12 seconds	271.8
Admit guidance steering	MES + 20 seconds	279.8
CENTAUR main engine cutoff	Injection	715.1
CENTAUR main engine cutoff backup (1)	a_T 6 feet/second^2	---
Third stage spinup (ignites third stage spin rockets, 1-second delay switches, 15-second delay motor ignition fuse, and starts separation timer)	MECO + 70 seconds	785.1

Table 1. Sequence of Events (Nominal Times) (Cont'd)

Event	Criteria Reference	Time From Launch (seconds)
Fire third stage wire cutters	Spinup + 1 second	786.1
Third stage/CENTAUR separation	MECO + 72 seconds	787.1
Start CENTAUR retrothrust	MECO + 72.02 seconds	787.12
Third stage ignition	Spinup + 15 seconds	800.1
Third stage burnout	Propellant depletion	843.8
Spacecraft/third stage separation	Spinup + 160 seconds	945.1
Start third stage tumble maneuver	Spinup + 162 seconds	947.1
Note: At MES + 390 seconds, a software enable for third stage spinup/ignition is provided by DCU logic which also causes the DCU to initiate MECO backup acceleration tests. If an acceleration of less than 6 feet/second^2 is sensed, the engines are assumed shut down and the post MECO sequence of events is initiated.		

D. POST LAUNCH OPERATIONS

The ETR and the Goddard Space Flight Center (GSFC) have the responsibility for tracking through stage III Yo deploy. Responsibility for telemetry coverage while the spacecraft is within view of their respective stations is assigned to the Kennedy Space Center (KSC), ETR, and GSFC.

SECTION II
LAUNCH OPERATIONS PLAN

A. OPERATIONAL AREAS

1. Complex 36. All Pioneer G launch vehicle and pad operations during the launch countdown are conducted from the blockhouse at Complex 36 (figure 4) by the Launch Conductor. Countdown readiness and status of the ATLAS, CENTAUR, and third stage are the responsibility of the appropriate contractor Test Conductor. The Spacecraft Controller in the blockhouse controls spacecraft activities and reports on the countdown readiness and status of the spacecraft to the Launch Conductor. Overall management of launch operations is the responsibility of the Operations and Launch Director. The Test Controller functions as the official contact between test personnel and the ETR.

2. Building AE. Two major operational areas for the Pioneer G mission are located in Building AE. These operational areas are the MDC and the Launch Vehicle Telemetry Ground Station. Figure 4 shows the location of the launch and operational areas.

a. Mission Director's Center. The launch operations and overall mission activities are monitored by the Mission Director in the MDC (figure 5) where he is informed of launch vehicle, spacecraft, and tracking network flight readiness. From the information presented, the Mission Director will determine whether or not the mission will be attempted. Appropriate prelaunch and realtime launch data are displayed to provide a presentation of vehicle launch and flight progress. The MDC also functions as an operational communications center during launch operations.

The front of the MDC consists of large illuminated displays including a list of tracking stations, Range stations in use, plotting boards, and a sequence of events after liftoff.

Three plotting boards are located at the center of the display and are used to show present position and Instantaneous Impact Plot (IIP) and, in most cases, doppler information. These displays, when plotted with the theoretical plots, give an overall representation of launch vehicle performance.

b. Launch Vehicle Telemetry Ground Station. The launch vehicle telemetry ground station receives, monitors, and records launch vehicle telemetry signals during prelaunch checkout to assist in determining vehicle launch readiness. After liftoff, realtime analysis of telemetry data will be used to determine vehicle performance for display in the MDC.

3. Building AO. The Pioneer G spacecraft countdown will be conducted from the Spacecraft Control Center (SCC) located in Building AO by the spacecraft Test Conductor and the Pioneer G crew. Spacecraft data, received in response to program functions generated by the SCC, are stored and analyzed to determine the launch readiness and status of the spacecraft.

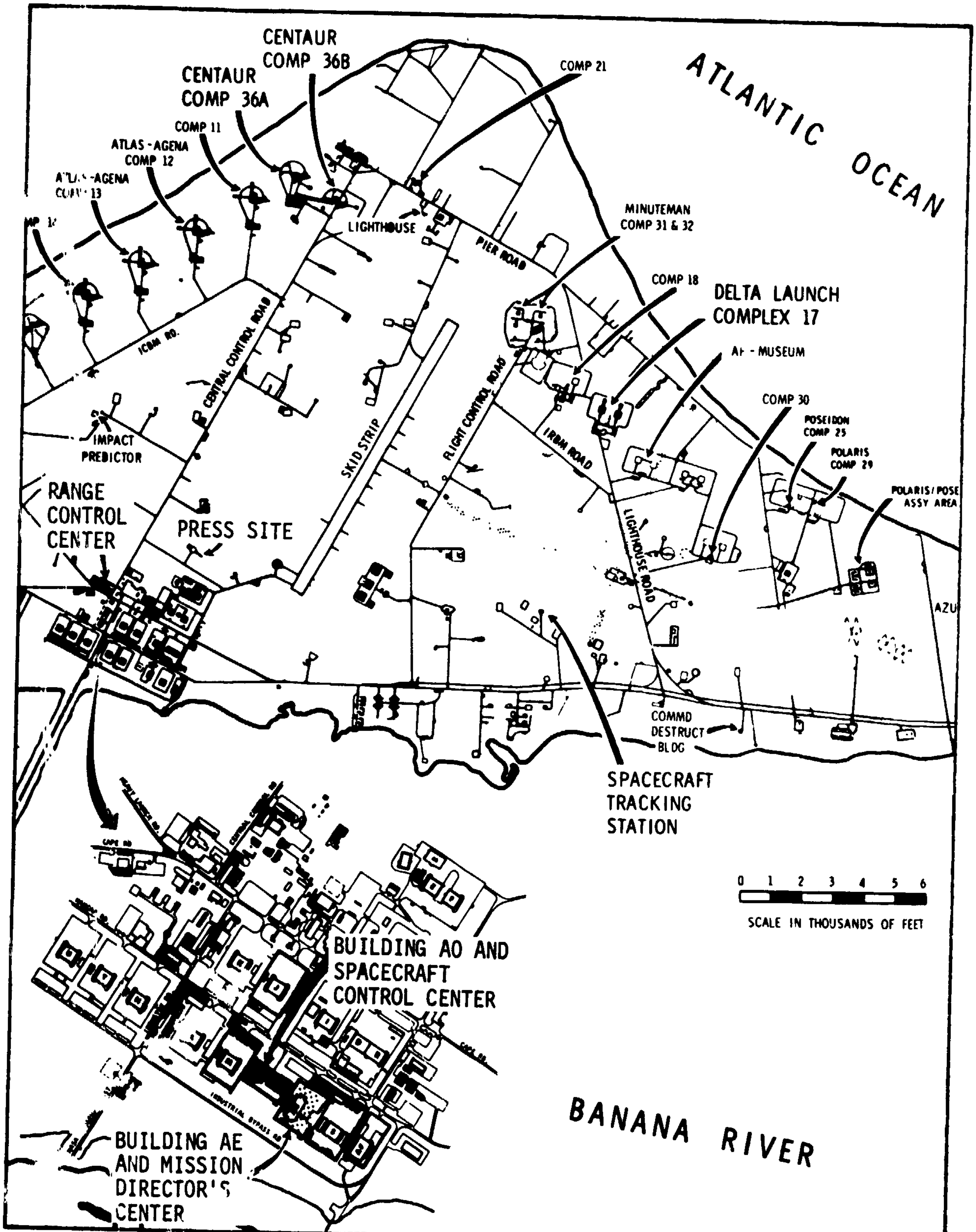


Figure 4. Launch and Operational Areas

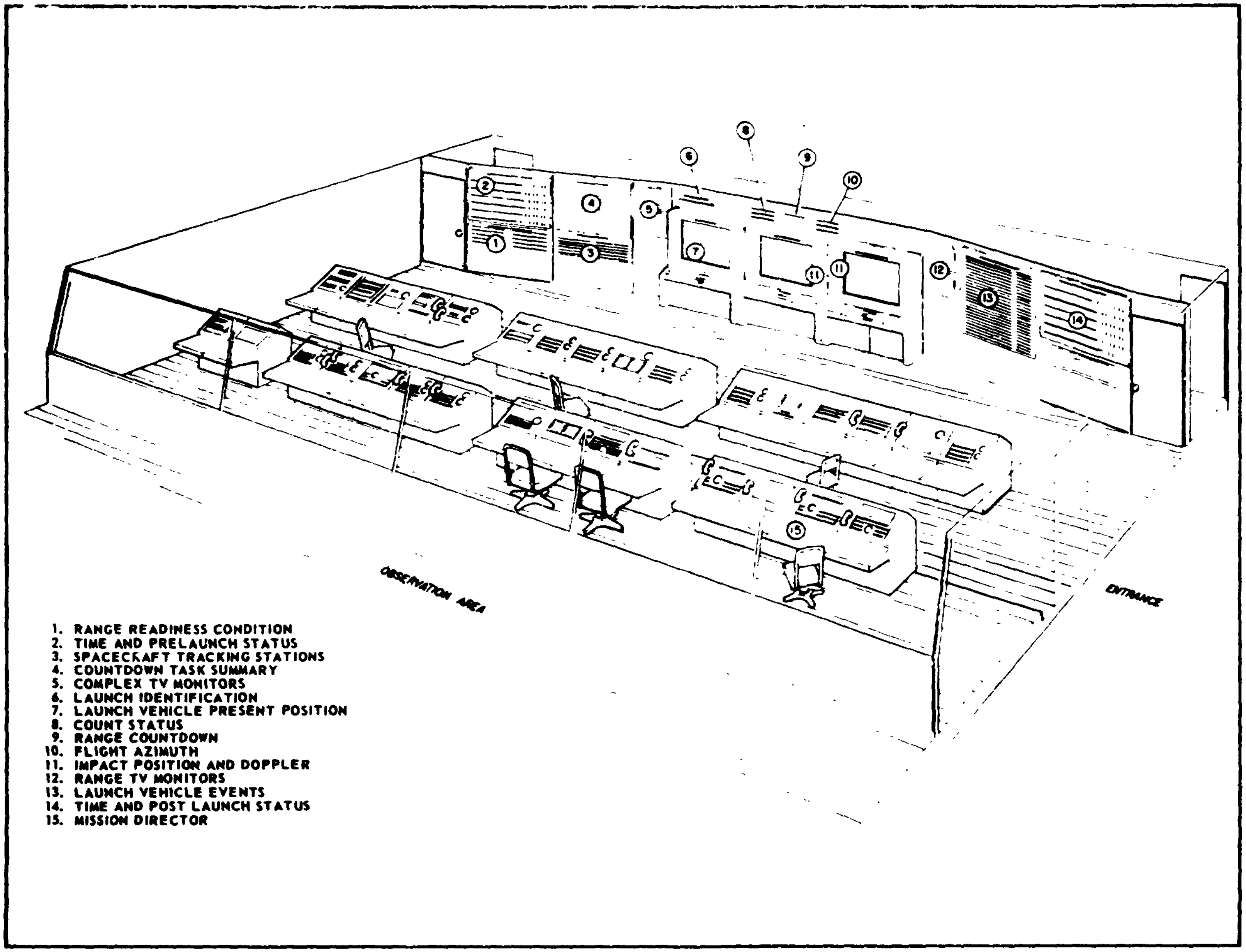


Figure 5. Mission Director's Center

4. Spacecraft Tracking Station (STS). The STS will doppler-track the Pioneer G launch vehicle from liftoff through Loss of Signal (LOS). The doppler data will be transmitted to Building AE for display and to GSFC in realtime for display in the Operations Control Center (OPSCON). Launch vehicle and spacecraft telemetry signals will be received and recorded, and certain links relayed to AE for processing.

5. Range Control Center (RCC). Overall management of ETR support during the launch countdown is provided by the Superintendent of Range Operations (SRO). Coordination with the SRO is provided by the Test Support Coordinator in the RCC and by the Test Controller in the blockhouse. A ULO representative will be present in the RCC to monitor and comment on trajectory and Range safety matters during flight.

B. DATA ACQUISITION

Telemetry, optical, and radar data acquisition will be provided by equipment located at Cape Kennedy and by downrange instrumentation sites (figure 3) during the prelaunch, launch, and injection phases of the ATLAS/CENTAUR-30 mission. The active stations for the mission are as follows:

ETR Stations	
Radar:	1, 7, 91, and 12
Telemetry:	91, supported by Apollo Range Instrumentation Aircraft (ARIA), and 12
Range Safety Support:	1, 3, 7, and 91
GSFC Stations	Bermuda (BDA), Canary Island (CYI), Range Instrumentation Ship (RIS) Vanguard (VAN), Ascension Island (ACN), and Tananarive (TAN)
KSC Stations	Central Instrumentation Facility (CIF), AE, and STS
Deep Space Network Stations	Cape Kennedy Air Force Station (CKAFS), Deep Space Station (DSS-71), and Johannesburg DSS-51

1. Telemetry. During ATLAS/CENTAUR-30 launch operations, airborne telemetry data will be acquired by five Cape area ground stations in realtime and on magnetic tape. Each of these stations will have specific assignments for realtime displays and playbacks so that the data may be reduced and distributed on a timely basis to fulfill analysis requirements. The formats for realtime displays are described in the recorder assignments table of the ATLAS/CENTAUR-30 Data Supplement (TR-1218). During flight, telemetry will be recorded by Antigua, Ascension, one ARIA, and the GSFC stations Bermuda, RIS Vanguard, and Tananarive. Spacecraft telemetry will be recorded by Building AE, Spacecraft Tracking Station, Central Instrumentation Facility, Bermuda, Antigua (ANT), RIS Vanguard, Canary Island, and Ascension Island.

a. Uprange Telemetry.

(1) AE Telemetry Ground Station. The Building AE ground station will concentrate on the ATLAS, CENTAUR, and third stage playback of all other data for evaluation on a timely basis. The Building AE station will record on 1 inch magnetic tape at 30 inches/second starting at bus 1 turn on. The data will be displayed on 8-channel Sanborn recorders from turn on to LOS with Range timing displayed on the records. Playbacks of the telemetry tapes following launch will use identical formats, although special records for detailed analysis will also be processed through this station. Airborne events will be recorded on a line printer.

(2) KSC, Central Instrumentation Facility. The primary function of the KSC-CIF ground station is to process the digital data through the two GE 635 computers to obtain performance information from the guidance system. In addition, selected data will be processed to obtain graphical printouts in engineering units. The CIF station will record all launch vehicle telemetry links on 1-inch magnetic tape at 30 inches/second from T-70 minutes to LOS. The guidance data will be processed in realtime. Post launch data will consist of guidance data and digital data of analog measurements. The CIF antenna site will remote the ATLAS and CENTAUR vehicle telemetry video signals to Building AE for processing and display and will also remote spacecraft telemetry to Building AO.

(3) Hangar J and Blockhouse 36. The GD/C telemetry station in Hangar J and Blockhouse 36 will provide support as required. The primary function of the Hangar J station is to record ATLAS telemetry data. The primary function of the Blockhouse 36 station is to check out and determine flight readiness of airborne telemetry systems, and to provide data to the Computer Control Launch Set (CCLS) and blockhouse recorders. A secondary function is to record selected data items.

b. ETR, GSFC, and DSN Telemetry Support. Class I telemetry requirements placed on the ETR, the GSFC, and the DSN are from Acquisition of Signal (AOS) to LOS from the ETR station at Antigua for the CENTAUR, the GSFC station at Ascension and the GSFC RIS Vanguard for the third stage, and DSS-71 for the spacecraft. Class II telemetry requirements will be supported by the ETR ARIA, Ascension Island, DSN DSS-71, and GSFC stations at Merritt Island Unified S-Band (USB), Bermuda, RIS Vanguard, Canary Island, and Tananarive.

2. Optics. Twenty-five engineering sequential cameras will provide coverage from T-4 minutes to T+10 minutes. Two of these cameras are of the long focal length type (ROTI-IGOR) that will be tracking from Acquisition of Signal (AOS) through Loss of Vision (LOV). Also included is a long range tracker (Patrick IGOR) that will provide live TV for display and recording in Building AE and display and recording on blockhouse monitors. An additional twenty-six documentary cameras will record various launch operations.

3. Radar Tracking, C-Band. Stations with acceptable viewing, including ETR C-band radars 0.18, 1.16, 19.18, 7.18, 91.18, and 12.16 along with Goddard radar stations at Bermuda, RIS Vanguard, Tananarive, and Carnarvon will utilize beacon and/or skin track to provide vehicle position and velocity data; realtime position and velocity information for Range Safety; inputs to the Realtime Computer System (RTCS) for determination of powered flight impact prediction; free flight orbital computation; and GSFC and DSN acquisition information.

4. Spacecraft Tracking Station. The ULO STS will track the spacecraft during launch operations and provide launch doppler information for display in the Mission Director's Center and spacecraft telemetry data to the SCC.

5. GSFC Support. Goddard stations at Bermuda, Canary Island, RIS Vanguard, Ascension Island, and Tananarive will support the launch of AC-30. Telemetry data will be recorded at all stations. Mark events will be provided through the Goddard communications net.

6. Other Data. A Preliminary Test Report (PTR) will be prepared by the Range within 3 hours after test termination. In addition to the normal PTR items, launch azimuth and predicted orbital elements will be included.

7. Range Safety.

a. Weather Restrictions. There are no Range Safety weather restrictions on this launch.

b. Skyscreens. One Vertical Wire Skyscreen (VWS) will be operated from launch to LOV to provide information on azimuth and program deviations. Two video (TV) screens will be operated from launch to LOV. This information will be presented to flight line and pitch program monitors in the RCC.

c. Instantaneous Impact Plot. The RTCS (3600) will be operated to compute and display an IIP on an X-Y plotter in the RCC. Primary inputs will be provided by C-band radars.

8. Mark Events. Table 2 contains measurements which will indicate mark events. These events will be called out on OIS channel 1 from AE as soon as observed. All mark events are on telemetry link 2202.5 MHz except mark events 12, 13, 14 and 15.

Table 2. Mark Events for AC-30

Mark No.	Event	T+Time in Seconds	Measurement No. and PCM Address	Measurement Description
	Liftoff (2-inch motion)	T=0		2-inch motion from Range readout
1	ATLAS BECO	139.1	AP83B 041/01/001/24/0 AP84B 042/01/001/24/0	B-1 pump speed (AP84B) & B-2 pump speed (AP83P) go from approx. 20% to 100%.

Table 2. Mark Events for AC-30 (Cont'd)

Mark No.	Event	T+Time in Seconds	Measurement No. and PCM Address	Measurement Description
2	ATLAS booster jettison	142.2	AF125P 204/01/006/04/0 AP26P 208/01/004/04/0	Booster control reg (AF125P) goes from approx. 70% to 0%. Booster lox reg Ref (AP26P) goes from approx. 45% to 0%
3	CENTAUR insulation panel jettison	184.1	AA201X 101/01/002/12/1 AA204X 101/01/002/12/2 AA205X 101/01/002/12/3 AA208X 101/01/002/12/4	Word bit for each breakwire goes from one to zero.
4	ATLAS SECO and VECO	247.9	AP349B 043/01/001/24/0	Sustainer pump speed (AP349B) goes from approx. 40% to 100%
5	ATLAS/CENTAUR separation	249.9	CM37D 107/01/001/12/0	Separation extensiometer goes from 0% to 100%.
6	CENTAUR MES	259.4	CP46P 012/02/001/24/0 CP47P 047/02/001/24/0	C-1 and C-2 chamber pressures (CP46P & CP47P) go from 0% to approx. 75%.
7	Jettison nose fairing	271.4	CM267X 101/01/001/12/1 CM293X 101/01/001/12/2	Word bit for each breakwire goes from one to zero.
8	CENTAUR MECO	709.6	CP46P 012/02/001/24/0 CP47P 047/02/001/24/0	C-1 and C-2 chamber pressures (CP46P & CP47P) go from approx. 75% to 0%.
9	TE-M-364-4 (Stage III) spinup	779.6	CY48B 101/01/001/12/3	Word bit alternates between zero and one as table rotates.
10	TE-M-364-A separation	781.6	CM61X 223/01/018/01/5 CM62X 223/01/018/01/6	Word bit for each separation relay goes from one to zero.

Table 2. Mark Events for AC-30 (Cont'd)

Mark No.	Event	T+Time in Seconds	Measurement No. and PCM Address	Measurement Description
11	CENTAUR retro-thrust	781.62	CM65X 223/01/019/01/7 CM66X 223/01/019/01/8	Word bit for each retro relay goes from one to zero.
12	TE-M-364-A ignition	794.6	Telemetry link 2250.5MHz VCO No. 13, 14.5 KHz	Chamber pressure goes from approx. 0% to approx. 60%.
13	TE-M-364-A burnout	838.4	Telemetry link 2250.5 MHz VCO No. 13, 14.5 KHz	Chamber pressure goes from approx. 60% to approx. 0%.
14	Spacecraft separation	939.6	Telemetry link 2250.5 MHz VCO No. 14 & 15, 22 & 30 KHz	Pitch and yaw accelerometers exhibit damped oscillations
15	Yo deploy	941.6	Telemetry link 2250.5 MHz VCO No. 14 & 15, 22 & 30 KHz	Pitch and yaw accelerometers display a 0.5 Hz oscillation of approx. 15%.

9. Data Evaluation Plan. This plan describes the manner in which telemetry data will be recorded and evaluated during the launch countdown. A data supplement to the plan has been issued under separate cover (TR-1218) containing detailed instrumentation assignments.

a. Airborne Telemetry. Two telemetry transmitters will be flown on the AC-30 vehicle, one on the ATLAS stage and one on the CENTAUR stage. Transmitter characteristics are shown below.

System	Stage	Radio Frequency	Nominal Power Output
PCM	CENTAUR	2202.5 MHz	7.0 watts
--	Third Stage	2250.5 MHz	3.0 watts

b. Instrumentation Assignments. The pertinent information defining telemetry location, gage range, and channel assignment for each measurement is contained in a series of supplemental tables (TR-1218) to provide a rapid reference for the following:

(1) A summary of the composite instrumentation for AC-30 (Data Supplement, table 1).

(2) Listings by systems of the telemetry channel assignment and gage range of each airborne ATLAS and CENTAUR measurement (Data Supplement, table 3).

(3) Same as above except measurements are listed by PCM address (Data Supplement, table 4).

(4) A listing by system of all landline measurements (Data Supplement, table 5).

c. Prelaunch Evaluation. All ATLAS/CENTAUR and spacecraft telemetry will radiate as listed below. Early checks will be monitored for the performance of all measurements and RF quality. This will be an aid in determining mission readiness. Following each check, records will be examined and the status of every measurement determined. All discrepancies will be reported to and reviewed by the Test Conductor, Launch Director, and Mission Director. The complete analysis will be accomplished in approximately 45 minutes.

Links	Start	Complete
Three	T-500 min	T-290 min
Three	T-90 min	T-50 min
Three	T-10 min	LOS

All stations (Hangar J, Blockhouse 36, Building AE, and KSC-CIF) will monitor telemetry during each of the periods of radiation and on the landline loop when not radiating (continuous monitoring from bus 1 turn on).

Evaluation of data requires approximately 45 minutes following acquisition. After evaluation, all results will be summarized by the ULO instrumentation representative in Building AE and transmitted to the Mission Director in Building AE and the Launch Director in Blockhouse 36, over Operational Intercommunication System (OIS) channel 14 (NASA data). Results of these evaluations will aid in determining mission readiness.

d. KSC Data Support. The KSC telemetry station and computer data reduction facility is available to support CENTAUR data requirements during prelaunch and post launch operations. Support is received from these facilities to provide the following data:

(1) Guidance system measurement (position, velocity, steering commands, and gyro drift) printouts of the airborne computer flight program in digital form.

(2) Orbital elements for spacecraft injection and vehicle post blowdown based on guidance data, provided to MDC by the KSC computer.

(3) Realtime display of guidance and Event Monitor Systems (EMS) and landline analog data at Blockhouse 36 and Building AE.

(4) Post reduction of item (3) data.

10. Data Distribution. Following launch, flight data will be available to applicable personnel for preparation of a verbal report at T+3 hours and a written report at T+8 hours. These data will be available for general inspection following these reports.

The KSC photo group will collect and distribute all photo... ...ic data. All other data will be picked up by the KSC data group for distribut... ...o cognizant project personnel. Data distribution lists are documented in the KSC Requirements Document (RD) 3600 and ETR Operations Requirements (OR) 3600.

a. Engineering Sequential Data. All engineering sequential data will be available within 5 working days after launch. Quick look (16 millimeter) expedited prints of the selected items will be available within T+8 hours upon request.

b. Telemetry Data. Uprange telemetry magnetic tapes are normally available in T+4 hours. Downrange telemetry magnetic tapes (station 91, Antigua) are available in 3 working days. Telemetry realtime data are presented in graph form at T+1 hour. Link 2202.5 will be transmitted from station 91 in realtime and provided in realtime to KSC for guidance data reduction, and to Building AE for processing and analysis.

c. Metric Data. Final reduced data for position and velocity will be available in 4 working days after receipt of tapes from ETR stations.

d. Best Estimate of Trajectory (BET). This document, including estimates of accuracy, will be available in 15 working days.

C. METEOROLOGICAL PLAN

The NASA Test Support Office (NTSO) is the only authorized contact with the Cape Kennedy weather station. Therefore, project and operations personnel will be furnished meteorological data only by the NTSO. From T-5 hours through T-0, all questions concerning weather forecast and observations will be referred to the NTSO representative in the RCC. Prior to this period, NTSO personnel may be contacted as listed below:

	Home	Office
R. J. Mazurkiewicz	262-2719	867-3962

From T-5 hours through T-0, the LeRC representative will monitor OIS channel 20 and stand by for green telephone calls from the NTSO representative in the RCC.

1. Prelaunch Forecasts.

a. Upper Air. Upper air data will be read from a Winsonde printout at the Cape weather station (RCC) and will include wind velocity, wind direction, and wind shear in 1,000-foot increments.

b. F-3 Day. A launch area forecast will be called to the NTSO for dissemination. The forecast will include general weather conditions expected for T-0 and a general weather outlook for the period F-3 Day through F-0 Day. This information will be telephoned by the NTSO to the CENTAUR operations office.

c. F-2 Day. A launch area forecast will be called to the NTSO for dissemination. The forecast will include surface conditions (cloud cover, visibility, precipitation, wind, temperature, and sea level pressure), upper level winds (surface to 50,000 feet at 5,000-foot intervals), and maximum wind shear expected at T-0.

2. F-0 Day Transmission of Bending Moment Data. In addition to being tabulated for verbal relay to project and operations personnel at ETR, the upper air data (200-foot intervals) are printed out on IBM cards and transmitted on IBM transceivers directly to San Diego by AFETR and to LeRC by GD/C. Approximately 45 minutes after receipt, the IBM 7094 computer output and recording equipment will have printed out tabulations and graphs of bending moment data at critical vehicle stations versus time of flight. The flight pitch and yaw steering programs will be determined by these data.

As soon as it becomes available, applicable go/no-go information from the tabulations will be telephoned from San Diego to the LeRC weather representative at Building AE to aid in making prelaunch decisions. The graphs will then be hand-carried from the computer room to the LeRC-San Diego office and datafaxed to ETR. The KSC datafax facilities in the Building AE/MDC (Fax No. 7-4111) will be used to receive the incoming bending moment graphs from San Diego. The data fax will be delivered by the LeRC weather representative or his alternate.

When sufficient time is available for receipt and evaluation of graphs, the final launch decision will be made only after evaluation of the bending moment data from these graphs. The verbal report from the tabulations will be considered preliminary in all cases except where time is the predominant consideration.

Upper air data will be obtained from the ETR Jimsphere, Rawinsonde and Winsonde systems, with data being transmitted from Hangar J to LeRC by IBM 066068 card transceiver and from the RTCS to GD/C San Diego by IBM 1050 card transceiver.

Bending moment upper air data will be obtained from weather balloons. On F-1 day a Windsonde balloon will be released at approximately 1100 hours EST. On F-0 day weather balloons will be released as follows: Windsonde with Jimsphere as backup at 0-6 hours and 30 minutes, 0-3 hours and 50 minutes, and 0-2 hours and 30 minutes; Windsonde at 0-1 hour and 20 minutes; Rawinsonde at 0-40 minutes; Jimsphere at T+10 minutes.

SECTION III
COMMUNICATIONS

A. GENERAL

The Pioneer G communications facilities which will be available for support of this mission are described in this section. These facilities will be used for prelaunch operations and early post flight intercommunications. The mission center will be located in the Mission Director's Center, Building AE.

B. MISSION DIRECTOR'S CENTER

Consoles in the MDC provide the assigned MDC personnel with the communications systems required to monitor and participate in vehicle and mission progress. The center's communications facilities provide the means for commuicating with Cape stations (Blockhouse 36, STS, Range Control Center), downrange stations, NASA headquarters, ARC, LeRC, GSFC, and worldwide tracking stations. Communications systems available at the consoles in the MDC are described below.

1. Black Telephones. The black telephones used in this system are special dial phones installed in the consoles that enable MDC personnel to place or receive local and long distance calls. Individuals assigned to consoles may establish, listen to, or participate in conference calls on the black telephone system.

2. Green Telephones. The ETR green telephone system utilizes manually operated key panels at each console, limiting the number of users. This provides rapid direct communications between all sites participating in this launch operation. The key cabinets provided for this system have both visual and audible signaling.

3. Station Conferencing and Monitor Arrangement (SCAMA) Telephone System. The SCAMA telephones provide direct contact with the GSFC SCAMA switchboard at Greenbelt, Maryland, for instantaneous long distance communications with the NASA global satellite tracking networks. SCAMA, originally designed to support the manned spacecraft network, has been extended to include the STADAN network (formerly called Minitrack). SCAMA can now link any combination of 51 communications points in NASA's global satellite tracking networks.

4. Operational Intercommunications System (OIS). The OIS is a Range intercom system which operates on a channel select basis rather than on an individual station-to-station basis. (This system was formerly called the MOPS network and most consoles still display that designation. The designation MOPS and OIS are synonymous.) All related operating positions, such as those for telemetry, are connected in parallel and the end instruments may communicate only with the channels to which connected. Access to individual channels may be limited to certain operators. When an operator selects a channel and talks, all other operators who have previously selected the same channel will hear him; conversely, he will hear all other operators talking on that same channel.

During the Pioneer G launch, various operations are assigned specific OIS channels. Because of this assignment system and the limited number of channels available at some of the outlying stations, it is mandatory that only assigned channels be used. Table 3 shows the OIS system channel assignment.

5. Leased Voice Circuits. NASCOM voice circuits are used for voice and data communications in support of launch operations. The leased voice circuits are as follows:

a. LL-1 ETR STATUS - Launch coordination with the SFOF

b. LL-2 PROJECT - Telemetry data coordination

c. LL-3 DSN - ETR - Spacecraft telemetry coordination

d. LL-4 NAV - Realtime computer coordination

e. LL-5 NETWORK CONFERENCE - MSFN station status

f. LL-6 MISSION DECISION - Project coordination

g. LL-7 VOICE OF PIONEER - Post flight event reporting

h. LL-8 COMMAND - Project coordination

i. LL-9 LAUNCH STATUS - Realtime flight events

j. LL-10 TTY COORD - Realtime data coordination

k. LL-11 TLM COORD - Realtime data coordination

l. LL-12 COW - Communications coordination

6. Post Liftoff Channels (OIS).

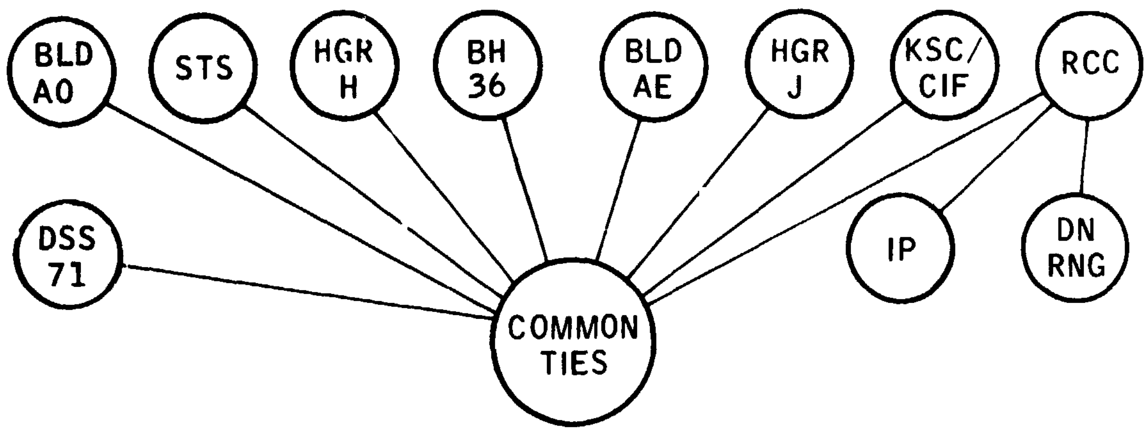
a. Channel 2. This channel will be used for flight events.

b. Channel 10. This channel will be used for Range safety and trajectory commentary.

c. Channel 16. Liftoff time and mark event times for the MSFN will be called out on this channel.

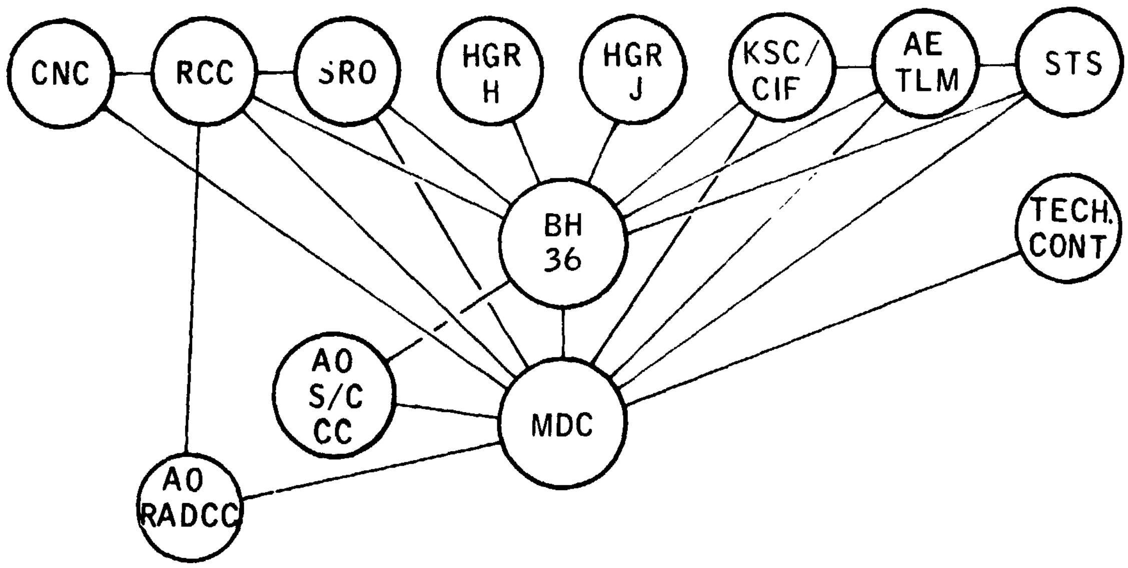
d. Channel 20. This channel will carry the MDC commentary with regard to vehicle performance.

The OIS and green telephone network for the Pioneer G launch are shown in figures 6 and 7 respectively.



AO	- SPACECRAFT CONTROL CENTER
BH	- BLOCKHOUSE COMPLEX 36
BLD	- BUILDING
CIF	- CENTRAL INSTRUMENTATION FACILITY
DN RNG	- DOWN RANGE
DSS-71	- DEEP SPACE STATION
HGR	- HANGAR DESIGNATION
IP	- IMPACT PREDICTOR
KSC	- KENNEDY SPACE CENTER
RCC	- RANGE CONTROL CENTER, PROJ. REP.
RTCS	- REAL TIME COMPUTER SYSTEM
STS	- SPACECRAFT TRACKING STATION

Figure 6. Operations Intercommunication System Network



AO RADCC	- RADIOLOGICAL CONTROL CENTER
AO S/C CC	- SPACECRAFT CONTROL CENTER
BH	- BLOCKHOUSE COMPLEX 36
CIF	- CENTRAL INSTRUMENTATION FACILITY
CNC	- CAPE NETWORK CONTROLLER
HGR	- HANGAR DESIGNATION
KSC	- KENNEDY SPACE CENTER
MDC	- MISSION DIRECTOR'S CENTER
RCC	- RANGE CONTROL CENTER
S/C GND STA	- SPACECRAFT GROUND STATION
SRO	- SUPERVISOR RANGE OPERATIONS
STS	- SPACECRAFT TRACKING STATION
TECH CONT	- TECHNICAL CONTROL - COMMUNICATIONS
TLM	- TELEMETRY

Figure 7. Green Phone Network

Table 3. OIS Channel Assignments

Channel Title	Channel Assignment
Test conductor	1
Blockhouse monitor stand	2
ATLAS propulsion	3
CENTAUR propulsion	4
Vehicle electrical	5
Complex electrical	6
ATLAS autopilot	7
CENTAUR autopilot	8
Landline instrumentation	9
Telemetry and radio frequency	10
CENTAUR pneumatics and facilities	11
ATLAS pneumatics and launcher	12
Environmental control and water	13
NASA data	14
Propellant utilization	15
NASA engineering	16
Propellant/facilities	17
Guidance	18
Spacecraft test conductor	19
NASA project net	20
SRO	21
Pad safety	22
Spacecraft test operations	23
Mission director	24
Third stage telemetry	25
Third stage telemetry	26

7. Communications Circuits. Table 4 lists the communications circuits that will be used to transmit launch vehicle, spacecraft, and informational type data during prelaunch and post launch operations.

Table 4. Pioneer G Communications Circuits

Circuit	From	To	Subject	Type of Information
1	GSFC (Analog)	AE	L/V and S/C	Raw
2	Ascension	AE	L/V	Raw
3	Ascension	AE	L/V	Raw
4	GSFC (L/V)	AE	L/V	Raw
5	CIF-1	AE	L/V	Video
6	CIF-2	AE	L/V	Video
7	CIF-3	AE	L/V	Video
8	CIF-4	AE	L/V	Video
9	CIF-5	AE	L/V	Video
10	CIF-6	AE	L/V	Video
11	CIF-7	AE	L/V	Video
12	CIF-8	AE	L/V	Video
13	Realtime Computer System	AE	L/V	Video
14	Complex-36	AE	L/V	Raw
15	STS	AE	L/V	Raw
16	STS	AE	L/V	Raw
17	Antigua	AE	L/V	Raw
18	Antigua	AE	L/V	Raw
19	AE	CIF	L/V	Raw
20	CIF-B	AE	L/V	Raw

Table 4. Pioneer G Communications Circuits (Cont'd)

Circuit	From	To	Subject	Type of Information
21	CIF-C	AE	L/V	Raw
22	STS (Doppler)	AE	L/V	Raw
24	Range Safety TV	AE	Info	Video
25	Range Safety TV	AE	Info	Video
26	Complex-36	AE	Info	Video
27	Complex-36	AE	Info	Video
28	AE	CX-36	Info	Video
29	Intercept Ground Optical Recorder	AE	Info	Video
30	Weather (RCC)	AE	Info	Video
31	AE	STS	Info	Video
32	AE	CX-36	L/V	Raw
33	AE	CIF-A	L/V	Raw
34	AE	CIF-B	L/V	Raw
35	GBI	AE	L/V	Raw
36	Bermuda	AE	L/V and S/C	Raw
37	CIF-9	AE	L/V	Video
38	CIF-10	AE	L/V	Video

SECTION IV
TEST OPERATIONS

A. LAUNCH VEHICLE AND SPACECRAFT PRELAUNCH MILESTONES

The significant launch vehicle and spacecraft prelaunch milestones are presented in tables 5 and 6, respectively.

Table 5. Launch Vehicle Prelaunch Milestones

Event	Location	Date
ATLAS arrived at ETR	Hangar J	1-4-73
CENTAUR arrived at ETR	Hangar J	1-4-73
ATLAS erected	Complex 36B	1-9-73
CENTAUR erected	Complex 36B	1-10-73
Terminal Countdown Demonstration	Complex 36B	3-1-73
Flight Events Demonstration No. 1	Complex 36B	3-6-73
Mate Pioneer F to CENTAUR	Complex 36B	3-21-73
Flight Events Demonstration No. 2	Complex 36B	3-23-73
Composite Electrical Readiness Test	Complex 36B	3-29-73*
Radio Frequency Interference Test	Complex 36B	3-30-73*
F-3, 2, and 1 day activities	Complex 36B	4-2 through 4-4-73*
Launch readiness	Complex 36B	4-5-73*
*Planned dates		

Table 6. Spacecraft Prelaunch Milestones

Event	Location	Date
Spacecraft arrived at ETR	Building A0	2-15-73
Spacecraft performance checks conducted	Building A0	2-19 through 3-13-73
Transport spacecraft to ESA 60A (Propellant Loading Building)	ESA 60A	3-14-73
Mate third stage to Ground Transport Vehicle (GTV)	ESA 60A	3-12-73
Hydrazine loading	ESA 60A	3-16-73
TRW spacecraft weighing and final inspection	ESA 60A	3-17-73
Mate spacecraft to third stage	ESA 60A	3-18-73
Remove spacecraft red tags and encapsulate	ESA 60A	3-19-73
Transport spacecraft to Complex 36B and mate to CENTAUR	Complex 36B	3-20-73
Spacecraft integrated systems test	Complex 36B	3-22-73
Flight Events Demonstration	Complex 36B	3-23-73
Spacecraft and DSN final interface check	Complex 36B	3-28-73
Composite Electrical Readiness Test	Complex 36B	3-29-73*
Radio Frequency Interference Test	Complex 36B	3-30-73*
F-1 day and RTG installation	Complex 36B	4-4-73*
Launch readiness	Complex 36B	4-5-73*

*Planned dates

B. F-1 DAY OPERATIONS

The major operations occurring on F-1 day, with T-time matched to the Eastern standard time the event is scheduled to occur, are listed in table 7.

Table 7. Major F-1 Day Operations

Time (EST)	Count (Min)	Event
0230	T-840	Start countdown operations Vehicle power application Start LH_2 transfer line purge Start ATLAS propulsion launch preparations Start CENTAUR propulsion thrust section preparations Start CENTAUR hydraulic readiness test
0300	T-810	End vehicle power application Start IMG gimbal slew test
0330	T-780	Start Range Safety Command receiver sensitivity preparations
0450	T-700	Start telemetry and radio frequency systems early tests
0525	T-665	IMG gimbal slew test complete C-band system test complete
0530	T-660	LH_2 transfer line purge is complete
0550	T-640	End Range Safety Command receiver sensitivity preparations
0850	T-460	End LH_2 transfer line purge
0855	T-455	CENTAUR propulsion thrust section preparations complete CENTAUR hydraulic readiness test complete
0900	T-450	Start Range Safety Command test

Table 7. Major F-1 Day Operations (Cont'd)

Time (EST)	Count (Min)	Event
0920	T-430	Radio frequency silence established Start mechanical installation and electrical connection of ATLAS/CENTAUR destruct boxes and pyrotechnics Start third stage destruct hookup Range Safety Command test complete
1030	T-360	Mechanical installation and electrical connection of ATLAS/CENTAUR destruct boxes and pyrotechnics complete Start ATLAS mechanical installation and electrical connection of pyrotechnics
1130	T-300	ATLAS propulsion launch preparations complete
1230	T-240 (Approx.)	End ATLAS mechanical installation and electrical connection of pyrotechnics
1500	T-90	Start vehicle fairing closeout Start third stage closeout Third stage ordnance hookup is complete
1530	T-60	Third stage pyro relay box connection is complete Radio freauency silence may be lifted
1600	T-30	Start spacecraft RTG installation preparations
1630	T=0	Vehicle fairing closeout is complete Third stage closeout is complete Start RTG installation
2400	T+450	End RTG installation (spacecraft electrical checks complete)

C. F-0 DAY OPERATIONS

The major events of the countdown, with T-time matched to the Eastern standard time the event is scheduled to occur, are listed in table 8. All times listed are predicated on a launch that occurs within the first minute of the planned launch window.

Table 8. Major F-0 Day Operations

Time (EST)	Count (Min)	Event
0611	T-830	Spacecraft final electrical checks complete Start spacecraft ordnance installation
0801	T-720	Spacecraft ordnance installation complete Start spacecraft final preparations
1011	T-590	Spacecraft final preps complete
1036	T-565	Start flight control power application
1041	T-560	Clear stand and ramp area for third stage S and A arming check
1121	T-520	Start third stage finaling
1141	T-500	Flight control power application is complete
1231	T-450	Start telemetry and RF preparations
1236	T-445	Start flight sequence test
1251	T-430	Third stage finaling is complete
1301	T-420	Flight sequence test is complete Start flight control operational test
1401	T-360	Third stage S and A closeout complete
1421	T-340	Man stations for launch countdown operations

Table 8. Major F-0 Day Operations (Cont'd)

Time (EST)	Count (Min)	Event
1426	T-335	Range countdown starts Spacecraft final countdown
1436	T-325	Flight control operational test is complete Start IMG calibration
1511	T-290	Telemetry and C-band early checks are satisfactory
1736	T-145	IMG calibration is complete
1801	T-120	Start tower removal
1821	T-100	Start 60-minute built-in hold
1921	T-100	End of built-in hold
1923	T-98	Tower securing complete
1941	T-80	Start CENTAUR lox tanking
1956	T-65	Start ATLAS lox tanking
2011	T-50	Start CENTAUR LH_2 tanking
2039	T-22	Start Range Safety Command final test
2031	T-30	Start CENTAUR propellant utilization exercise
2043	T-18	Range Safety Command final test complete
2051	T-10	Start 10-minute built-in hold
2101	T-10	Built-in hold ends
2107	T-4	ATLAS to internal power
2109	T-2	CENTAUR to internal power
2109.30	T-1.5	Range launch clearance
2111	T=0	Launch (2-inch motion)